$K_L \to \pi^0 \mu e$ Status
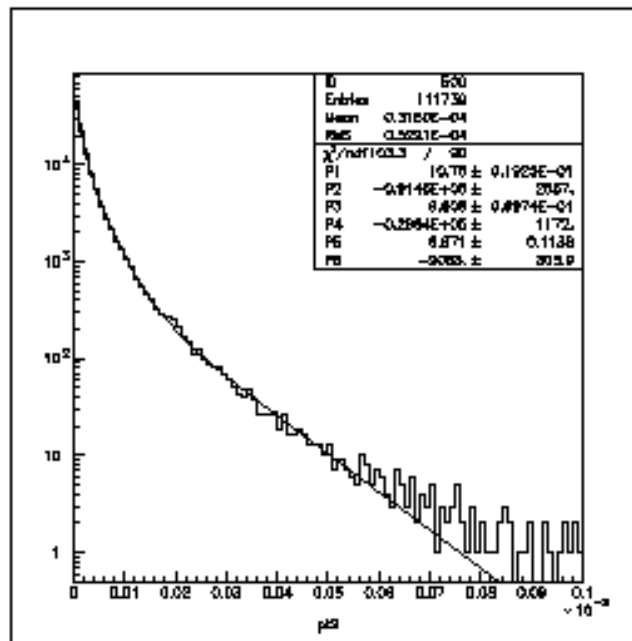
MDC, KTeV meeting, Sept 10, 2005

I have redefined the signal region by defining a likelihood variable which is the product of PDFs for the Kaon mass and p_t^2 distributions. Here is an example fit to the p_t^2 distribution for signal MC.
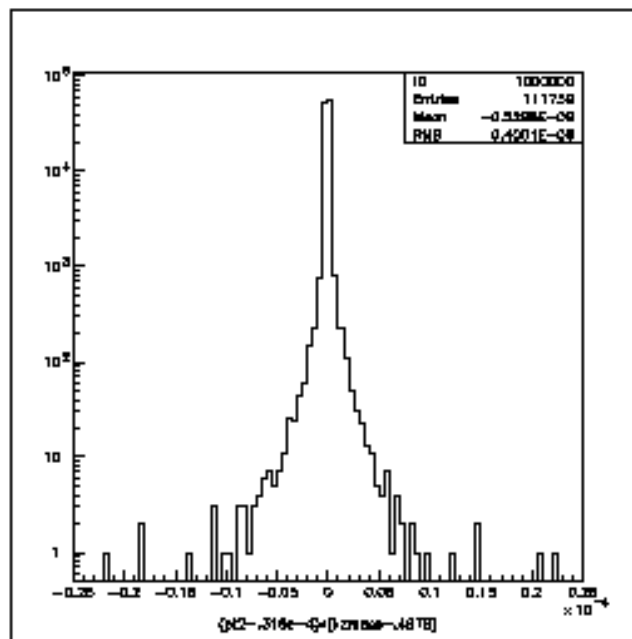

Fit to p_t^2 distribution for $K_L \to \pi^0 \mu e$ signal MC

$K_L \to \pi^0 \mu e$ Status

To be sure p_t^2 and K-mass are uncorrelated, look at the covariance:

$$< p_t^2 - < p_t^2 >> * < Kmass - < Kmass >>$$

Distribution of $(p_t^2 - < p_t^2 >) * (Kmass - < Kmass >)$ for signal Monte Carlo. The mean of this distribution is the covariance of these two variables, consistent with zero.

The likelihood variable is the product of the PDFs, and is shown below for signal MC. The signal region is defined as $pdf > 10$, and a blind region is defined as $pdf > 5$. The lower plot compares the new signal region with the old signal box.
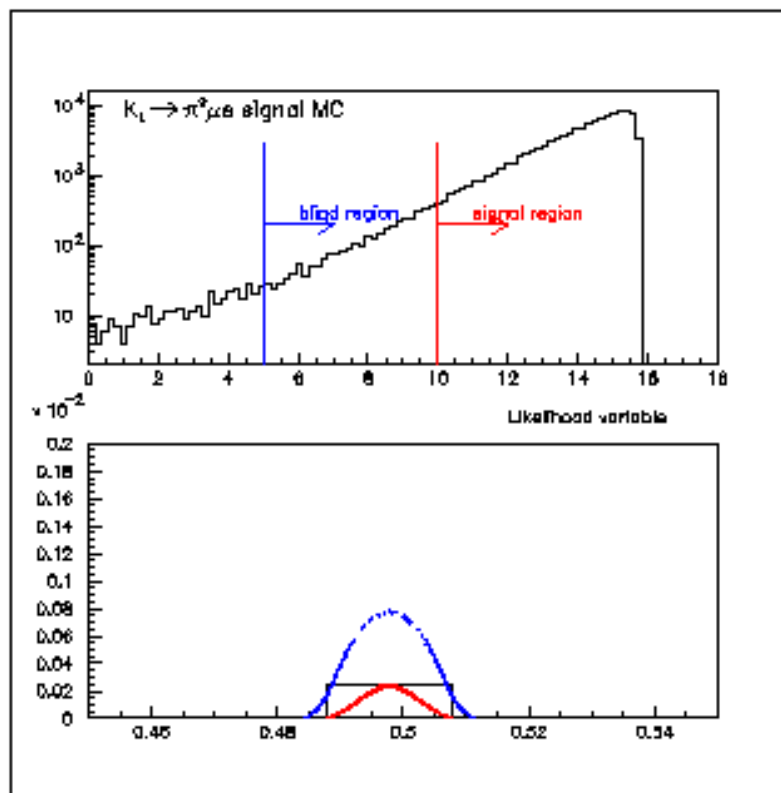

Top: Likelihood variable for signal Monte Carlo. Bottom: Comparison of the old signal box with the new signal region and blind region.

$$\boxed{K_L \to \pi^0 \mu e}$$

Background Estimate–K_{e4} decays

With the improved/corrected Monte Carlo and NA48 form factors, the expected K_{e4} background has increased a factor of 5. I have used NA48 form factors (very similar to Edivaldo's new KTeV FFs). The plot below shows the 40x flux K_{e4} Monte Carlo in the p_t^2 vs. Kmass plane.
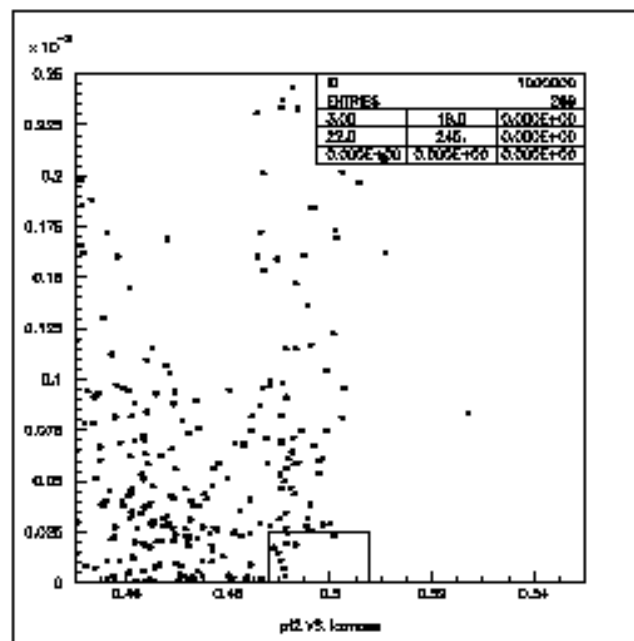
For 99 data:
K_{e4} background estimate in new signal region: 0.05 ± 0.035
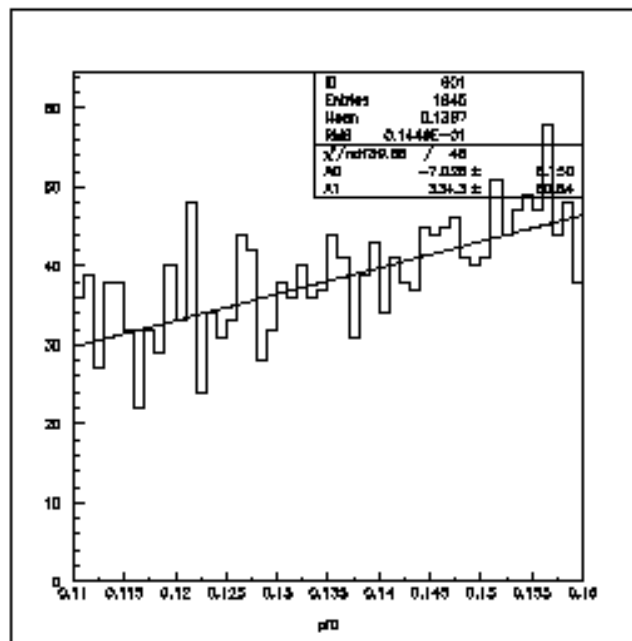K_{e4} background estimate in old signal region: 0.25 ± 0.08
For comparison the old estimate of K_{e4} in old signal region was 0.05 ± 0.05.

$$K_L \to \pi^0 \mu e$$

Non-K_{e4} background estimate from the data

I have tried several things but have the most confidence in the $M_{\gamma\gamma}$ sideband estimate. With all other cuts in place, the $M_{\gamma\gamma}$ distribution for the 99 data is shown below.

I *exclude* the M_{π^0} signal region and see what is in the *pdf* signal region, correcting by the ratio of the sideband area/signal area.

$M_{\gamma\gamma}$ distribution for 99 data, with all cuts except the M_{π^0} mass cut

These estimates *exclude* K_{e4} background.
Expected background in signal region ($pdf > 10$):0.31 ± 0.16
Expected background in blind region ($pdf > 5$): 1.33 ± 0.32

$K_L \rightarrow \pi^0 \mu e$ summary

For 99 data:

- Expected background in the signal region is 0.36 ± 0.16
- Expected background in the blind region is 2.1 ± 0.35
- Signal accepance is 0.036
- Apparent flux is 3.37×10^{11} K_L decays.
- If there are no events in the signal region, the 90%CL BR limit will be 1.7×10^{-10}.

For 97 data:

- Expected background in the signal region is 0.25 ± 0.14 events
- Expected background in the blind region is 1.03 ± 0.25.
- Signal accepance is 0.036
- Apparent flux is 2.82×10^{11} K_L decays.
- If there are no events in the signal region, the 90%CL BR limit will be 2.2×10^{-10}.

Combined 90% CL BR limit: 8.5×10^{-11}

See the long writeup
/cdserv/taku/private/ktevdoc/e799/kpi0mue/ktopi0mue.ps

$$\boxed{K_L \to \pi^0 \pi^0 \mu e}$$

(no change from last time)

For 99 data:

- Estimated background in the signal region is 0.5 ±0.14 events

- Signal accepance is 2.02%

- Flux is 3.76 ×10^{11} K_L decays.

- If there are no events in the signal region, the 90%CL BR limit is 2.7×10^{-10}.

For 97 data:

- Estimated background in the signal region is 0.1 ±0.05 events

- Signal accepance is 1.80%

- Flux is 2.64 ×10^{11} K_L decays.

- If there are no events in the signal region, the BR limit will be 4.9×10^{-10}.

Combined 90% CL limit from both 97 and 99 data would be (assuming no events are observed in the signal region) BR($K_L \to \pi^0 \pi^0 \mu e$) $< 1.5 \times 10^{-10}$

Please see the long writeup:

/cdserv/taku/private/ktevdoc/e799/kpi0mue/pi0mue.ps